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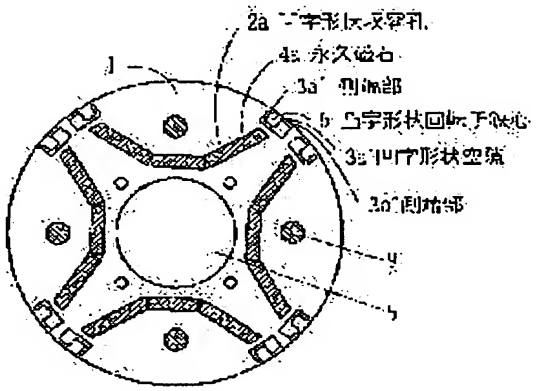
(54) ROTOR FOR MOTOR

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a rotor having high workability by reducing noises and vibrations due to cogging torque developed by a motor.
SOLUTION: This motor, including a rotor inside a stator, is an inward- rotating motor and comprises recessed accommodation holes, extending to the outer periphery of the rotor with the shaft hole of the rotor taken as its center. Permanent magnets are embedded in the recessed accommodation holes. There are provided clearances between the ends of the recessed accommodation holes and the outer periphery of the rotor, which are formed into recessed shapes. The cogging torque can be reduced, by dividing the rotor into a plurality of sections in the layering direction and displacing the recessed clearances by a prescribed angle in the circumferential direction of the rotor to reduce noises and vibrations. The rotor can be polarized with the stator assembled into a housing taken as a polarized yoke, thereby facilitating handling.



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* NOTICES *

CLAIMS

[Claim(s)]

[Claim 1] Are the motor of the introvert mold which has a rotator inside a stator, and it has the concave letter configuration hold hole with which the permanent magnet was embedded at said rotator. The rotator of the motor characterized by the edge of said concave letter configuration hold hole being extended, and being formed to said rotator periphery focusing on the boss of said rotator, and having an opening between the edge of said concave letter configuration hold hole, and a rotator periphery, and said opening forming the concave letter configuration opening.

[Claim 2] The rotator of the motor given in claim 1 term characterized by connecting said concave letter configuration hold hole for embedding said concave letter configuration opening and said permanent magnet.

[Claim 3] claim 1 term characterized by said concave letter configuration hold hole with which said rotator is divided in the direction of product thickness at plurality, and said permanent magnet is inserted, and said concave letter configuration opening having shifted to the hoop direction of a rotator by the predetermined include angle, or one of claim dyadic -- the rotator of the motor of a publication.

[Claim 4] claim 1 term characterized by only said concave letter configuration opening having shifted to the hoop direction of a rotator by the predetermined include angle, without shifting said concave letter configuration hold hole with which said rotator is divided in the direction of product thickness at plurality, and said permanent magnet is inserted, or one of claim dyadic -- the rotator of the motor of a publication.

[Claim 5] claim 1 term characterized by lengthening said concave letter configuration opening by the predetermined include angle toward a magnetic pole core, without shifting said concave letter configuration hold hole with which said rotator is divided in the direction of product thickness at plurality, and said permanent magnet is inserted, or one of claim dyadic -- the rotator of the motor of a publication.

[Claim 6] one of claim 3 ****** claim 5 terms characterized by said concave letter configuration opening having shifted to the hoop direction of a rotator by one half of the include angle of the slot pitch of a stator -- the rotator of the motor of a publication.

[Claim 7] one of claim 1 ****** claim 6 terms characterized by being the motor in which said rotator carried out opposite arrangement with the stator of the concentrated-winding method with which the direct coil was coiled around the tooth part of a stator -- the rotator of the motor of a publication.

[Claim 8] Are the motor of the introvert mold which has a rotator inside a stator, and it has the concave letter configuration hold hole with which the permanent magnet was embedded at said rotator. Focusing on the boss of said rotator, to said rotator periphery, the edge of said concave

letter configuration hold hole is extended, and is formed. In the rotator of the motor with which it has an opening between the edge of said concave letter configuration hold hole, and a rotator periphery, and said opening forms the concave letter configuration opening The magnetization approach of the rotator characterized by dividing said rotator in the direction of product thickness at plurality, and magnetizing by making a stator into magnetization York after said concave letter configuration opening is included in housing in the rotator which has shifted to the hoop direction of a rotator by the predetermined include angle.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the rotator of the motor used for an industrial device, an office machine, and the device for household electric appliances.
[0002]
[Description of the Prior Art] In recent years, generally the permanent magnet form motor which used the permanent magnet in the motor used for an industrial device, an office machine, and the device for household electric appliances is used increasingly. The structure of various rotators where secured the flux path and reluctance torque was used for the rotator of a permanent magnet form motor inside the magnet torque by the amount of magnetic flux of a permanent magnet or a rotator is proposed. When the motor engine performance was improved conventionally, although the quality of the material of the permanent magnet embedded to the interior of a rotator was high-performance-ized, or the amount used was increased and it had corresponded, there were cost and a structure upper limit community of a rotator.
[0003] A rotator like drawing 8 is proposed in this problem. Drawing 8 is the rotator of the permanent magnet flush type used for the motor of three phase 4 pole, and the adjacent permanent magnet 4 is arranged so that it may become a unlike pole. The hold hole 2 for inserting a permanent magnet 4 in the rotor core 1 centering on the rotator boss 5 is arranged to the rotator periphery at the radii configuration of the reverse sense. The opening 3 is formed near the rotator periphery of the hold hole 2 of this radii configuration. This opening 3 is greatly formed in the direction of a magnetic pole core, in order to make it concentrate on d shaft orientations which showed the magnetic flux generated with the permanent magnet 4 all over drawing. Thereby, magnetic flux can centralize the magnetic flux of the non-energizing section which will concentrate focusing on a magnetic pole and was seen from the motor control-side on the energization section, uses the magnetic flux of a permanent magnet without futility, and is raising the engine performance of a motor.
[0004]
[Problem(s) to be Solved by the Invention] However, while magnetic flux is centralized in such a motor and the engine performance of a motor can be improved, a sound, vibration, etc. which the outflow close difference of the magnetic flux between each pole becomes very large, and

originate in the cogging torque of a motor have occurred.
[0005] If the output of a motor becomes an overload greatly especially, a sound, vibration, etc. resulting from the cogging torque of a motor will appear notably.
[0006] Moreover, especially the opening 3 prepared near the rotator periphery of the hold hole 2 with which it is enlarged and a permanent magnet 4 is inserted in a rotor core 1 in a motor Focusing on a magnetic pole, centralize magnetic flux, and it is greatly formed toward the magnetic pole core. Since width of face of the yoke part between an opening 3 and a rotator periphery is made narrow very long and slender so that magnetic flux may not leak, it becomes insufficient [reinforcement]. Moreover, depending on the handling at the time of rotator manufacture The rotator periphery of this yoke part deforms, and a gap with a stator bore becomes uneven and poses an important problem in the quality side. This serves as a sound, vibration, etc. resulting from the degradation of a motor, and the cogging torque of a motor, and appears.
[0007]
[Means for Solving the Problem] Are the motor of the introvert mold which has a rotator inside a stator, and it has the concave letter configuration hold hole with which the permanent magnet was embedded at the rotator. Focusing on the boss of a rotator, the edge of a concave letter configuration hold hole is extended, and is formed to the rotator periphery, it has an opening between the edge of this concave letter configuration hold hole, and a rotator periphery, and things can be attained and carried out by considering as the rotator of the motor with which this opening formed the concave letter configuration opening.
[0008] Moreover, it can attain by connecting the concave letter configuration hold hole for embedding this concave letter configuration opening and permanent magnet.
[0009] Moreover, this rotator is divided in the direction of product thickness at plurality, and it can attain by considering as the rotator of the motor which the concave letter configuration hold hole and concave letter configuration opening where a permanent magnet is inserted shifted by the predetermined include angle to the hoop direction of a rotator.
[0010] Moreover, this rotator is divided in the direction of product thickness at plurality, and it can attain by considering as the rotator of the motor which shifted only the concave letter configuration opening by the predetermined include angle to the hoop direction of a rotator, without shifting the concave letter configuration hold hole with which a permanent magnet is inserted. Moreover, the same effectiveness can be acquired also by lengthening a concave letter configuration opening by the predetermined include angle toward a magnetic pole core.
[0011] Moreover, it can attain by considering as the rotator of the motor with which the concave letter configuration opening has shifted to the hoop direction of a rotator by one half of the include angle of the slot pitch of a stator.
[0012] Moreover, it can attain by considering as the rotator of the motor which carried out opposite arrangement with the stator of the concentrated-winding method with which the direct coil was coiled around the tooth part of a stator.
[0013] Moreover, said rotator is equipped with the concave letter configuration hold hole with which the permanent magnet was embedded. In the rotator of the motor with which the edge of a concave letter configuration hold hole is extended, and is formed to the rotator periphery focusing on the boss of this rotator, it has an opening between the edge of this concave letter configuration hold hole, and a rotator periphery, and this opening forms the concave letter configuration opening Said rotator is divided in the direction of product thickness at plurality, and after a concave letter configuration opening is included in housing in the rotator which has shifted to the hoop direction of a rotator by the predetermined include angle, it considers as the magnetization approach of the rotator which magnetizes by making a stator into magnetization York. For example, after a stator and a rotator are incorporated in the sealing compressor made into driving sources, such as a refrigerator and an air-conditioner, a rotator can be magnetized by making a stator into magnetization York.
[0014]
[Embodiment of the Invention] The example of this invention is explained using a drawing.
Drawing 1 forms nothing 4 poles for the unlike pole with permanent magnet 4a which has

concave' letter configuration hold hole 2a which inserts permanent magnet 4a in the rotor core 1 interior, and was inserted in adjacent concave letter configuration hold hole 2a. The monotonous permanent magnet with which permanent magnet 4a was divided into the center-section pars basilaris ossis occipitalis and the concave letter configuration hold hole flank is inserted in concave letter configuration hold hole 2a. Between this concave letter configuration hold hole 2a and the rotator periphery section, it has concave letter configuration opening 3a. The edge of concave letter configuration hold hole 2a was faced, the pars basilaris ossis occipitalis of concave letter configuration opening 3a has been arranged, and the edge of concave letter configuration opening 3a is arranged so that it may go to a rotator periphery. Therefore, when it sees from a rotator outer diameter, the convex typeface-like rotor core 6 where a part of rotor core 1 projects in a convex shape in the rotator bore direction is formed.

[0015] 0.35mm - about 2.0mm is good, and he is trying for the width of face between edge 3a' of concave letter configuration opening 3a and the rotator periphery sections which are located in a rotator magnetic pole core side to be desirable, and to saturate the magnetic flux generated between a rotator and a stator. What is necessary is just to become about 2.0T as flux density. That is, it is made to turn to compulsorily the magnetic flux generated by permanent magnet 4a embedded at concave letter configuration hold hole 2a in order to centralize magnetic flux focusing on a magnetic pole focusing on a magnetic pole by edge 3a' of this concave letter configuration opening 3a, and the leakage of magnetic flux is prevented. By this, the magnet torque which contributes to the engine performance of a motor can be raised, and comprehensive torque can be raised.

[0016] Moreover, he is trying to saturate the magnetic flux generated between a rotator and a stator well [it is desirable and] 0.35mm - about 2.0mm like the edge 3a'edge of concave letter configuration opening 3a located in magnetic pole core side which mentioned above width of face between 'and the rotator periphery section 3a' width of face of concave letter configuration opening 3a located in a between [rotator magnetic pole poles] side. As flux density, that what is necessary is just to become about 2.0T also in this case again When even magnetic pole pole Mabe juts out more greatly than the width of face of concave letter configuration hold hole 2a edge 3a" of this concave letter configuration opening 3a Reluctance torque can be centralized [near the rotator periphery of the magnetic path of the rotor core 1 located between concave letter configuration hold hole 2a and the rotator bosses 5 which embedded permanent magnet 4a], and comprehensive torque can be raised.

[0017] Moreover, the **** rotor core 6 of the center of concave letter configuration opening 3a is broader than the width of face between edge 3a' of concave letter configuration opening section 3a and 3a", and the rotator periphery section. edge 3a' of this concave letter configuration opening section 3a, and 3a' -- when there is a **** rotor core 6 broader than ', magnetic flux can be gradually changed from magnetic pole pole Mabe who centralized reluctance torque toward the magnetic pole core on which magnet torque was centralized.

[0018] This example is explained in drawing 2 using a stator core 7 and a rotor core 1. It is equipped with the stator winding although not illustrated into the slot of a stator core 7. The magnetic flux from a stator core 7 goes into a stator core 7 again through a rotor core 1. The arrow head in drawing shows the flow of magnetic flux. This magnetic flux appears as roughness and fineness of very big magnetic flux between a rotator and a stator in that by which a motor is operated with a heavy load, or the enlarged thing. Therefore, magnetic flux can be gradually passed by establishing the convex typeface-like rotor core 6. That is, since magnetic flux will flow to a magnetic pole core side through concave letter configuration opening 3a, it is lost that a rapid change of magnetic flux starts. in this case, edge 3a" of concave letter configuration opening 3a by the side of magnetic pole pole Mabe -- near opening width of face -- edge 3a' by the side of a magnetic pole core -- it is desirable to set up more broadly than near opening width of face. He is trying for this not to have the leakage of the magnetic flux by the side of between magnetic pole poles. moreover -- reverse -- the opening width of face by the side of edge 3a' of concave letter configuration opening 3a by the side of a magnetic pole core -- edge 3a" by the side of between magnetic pole poles -- setting up more narrowly than near opening width of face -- edge 3a' -- it is for making it magnetic flux flow gradually to a magnetic pole

core side through a near opening. In addition, when the convex typeface-like rotor core 6 is changed into the condition of having lost the opening by the side of edge 3a' of concave letter configuration opening 3a, and having connected with the rotor core 1 by the side of a magnetic pole core, magnetic flux flows too much greatly and makes the motor engine performance get worse.

[0019] Moreover, it cannot be overemphasized by a part of magnetic flux from a stator once flowing to the convex typeface-like rotor core 6 by preparing this convex typeface-like rotor core 6 part, and being able to pass magnetic flux gradually and using together with said approach as another effectiveness, without passing big magnetic flux rapidly by returning to the tooth edge section 8 of a stator further, that better effectiveness is acquired.

[0020] Therefore, since he is trying for the roughness and fineness of a sink and rapid magnetic flux not to generate magnetic flux intentionally in the convex typeface-like rotor core 6 by preparing concave letter configuration opening 3a in the edge of this concave letter configuration hold hole 2a, the sound and vibration which are made to maintain the engine performance of a motor and originate in cogging torque can be reduced.

[0021] Moreover, when there is a convex typeface-like rotor core 6 of this concave letter configuration opening 3a, it becomes possible for the width of face of the yoke part between concave letter configuration opening 3a and a rotator periphery to become broad, and to raise the reinforcement of a yoke part. Therefore, it is lost that a rotator periphery deforms by the handling at the time of rotator manufacture etc., since the width of face of the yoke part between the opening sections of the rotator of a motor and the rotator peripheries which were enlarged especially becomes broad [the width of face of a yoke part] in what is formed long and slender, reinforcement goes up and the handling at the time of rotator manufacture becomes easy. The stator outer diameter in this example is desirable, phi180-phi120, and a bore are phi110-phi60, and the rated output of a motor can acquire remarkable effectiveness by applying to a 1 horsepower - about 5 horsepower thing preferably.

[0022] Moreover, drawing 3 explains another example. In addition, the rotator explained henceforth [drawing 3] attaches the notation same about the same thing as the component of a rotator used for drawing 1 and drawing 2 , and omits explanation. Concave letter configuration opening 3a prepared between the edge of concave letter configuration hold hole 2a where permanent magnet 4a extended on a rotator periphery was embedded, and concave letter configuration hold hole 2a and a rotator periphery is connected with drawing 3 , and it is formed in it as one hold hole. The yoke section of the rotor core 1 established between concave letter configuration hold hole 2a and concave letter configuration opening 3a is lost by this, and it can be made to concentrate effectively focusing on a magnetic pole, without leaking the magnetic flux from permanent magnet 4a which goes focusing on a magnetic pole. In addition, the thing with punching possible [the yoke section of the rotor core 1 between concave letter configuration hold hole 2a and concave letter configuration opening 3a which were explained by drawing 1 and drawing 2] for a rotor core 1 which it restricts and is considered as narrow does not need to explain.

[0023] Moreover, drawing 4 explains another example. It is the rotator which divided and carried out the laminating and which was shifted by the predetermined include angle to the hoop direction two in the direction of product thickness about the permanent magnet form rotator which equipped drawing 4 with concave letter configuration opening 3a at the edge of concave letter configuration hold hole 2a of a rotor core 1. In addition, when a rotator is divided into two in the direction of product thickness, a continuous line shows what equipped with concave letter configuration opening 3a the edge of concave letter configuration hold hole 2a at which upper permanent magnet 4a was inserted, and the broken line shows what equipped with concave letter configuration opening 3b the edge of concave letter configuration hold hole 2b at which permanent magnet 4b of the lower part shifted by the predetermined include angle was inserted. it becomes possible to reduce the sound resulting from the cogging torque which magnetic flux will carry out [torque] outflow close to the convex typeface-like rotor core 6 gradually, and is generated in a part for magnetic pole Mabe of a rotator, and vibration by being alike and considering as the appropriate rotator which the convex typeface-like rotor core 6 of concave

letter configuration opening 3a shifted by the predetermined include angle to the rotator hoop direction.

[0024] In this case, when the convex typeface-like rotor core 6 is shifted by the predetermined include angle, it is desirable to make it not overlap preferably in a rotator hoop direction. Although this must form the magnetic path which originally goes into a rotator from the tooth edge section 8 of a stator, and misses magnetic flux to the tooth edge section 8 of a stator, it is because magnetic flux escapes to the shaft orientations of a rotor core 1, so it will be connected with large degradation if the convex typeface-like rotor cores 6 by which the laminating was carried out overlap.

[0025] Moreover, like [drawing 5] drawing 4 , it is the permanent magnet form rotator which equipped the edge of concave letter configuration hold hole 2a of a rotor core 1 with concave letter configuration opening 3a, and concave letter configuration hold hole 2a in which permanent magnet 4a is inserted unlike the thing of drawing 4 is arranged without shifting, and only concave letter configuration opening section 3a shifts to the hoop direction of a rotator by the predetermined include angle, and it is arranged. In addition, similarly, the rotator shows said case where it divides into two in the direction of product thickness, shows as a continuous line what equipped with concave letter configuration opening 3a the edge of concave letter configuration hold hole 2a at which upper permanent magnet 4a was inserted, and shows only concave letter configuration opening 3c shifted by the downward predetermined include angle with the broken line.

[0026] In this case, concave letter configuration opening 3a may be shifted by the predetermined include angle to the hoop direction of a rotator, without changing the configuration of concave letter configuration opening 3a, and may lengthen the opening of concave letter configuration opening 3a to a magnetic pole core side. It is desirable to set up so that a part of opening of concave letter configuration opening 3c may surely lap with the width of face of concave letter configuration opening 3a in the former. If a rotator is shifted to a hoop direction so that the opening of concave letter configuration opening 3a and the opening of concave letter configuration opening 3c may not lap, in a part without the lap of this opening, magnetic flux will leak greatly, and the engine performance of a motor is made to get worse. moreover, in the latter, although the flow of the gradual magnetic flux by the side of the magnetic pole core explained in drawing 1 and drawing 2 came out through the opening of magnetic pole core side 3a' of concave letter configuration opening 3a, magnetic flux will flow gradually in this case from the opening by the side of the pars basilaris ossis occipitalis of concave letter configuration opening 3a, i.e., the edge of concave letter configuration hold hole 2a. Therefore, it becomes the opening section of the pars basilaris ossis occipitalis of concave letter configuration opening 3a to set up in this case more narrowly than the width of face of concave letter configuration opening 3a" by the side of between magnetic pole poles. As for the convex typeface-like rotor core 6 of concave letter configuration opening 3a, it is desirable to make it the former and the latter not lap in the direction of product thickness.

[0027] Moreover, what is necessary is just to insert permanent magnet of three sheets 4a, in order not to shift concave letter configuration hold hole 2a to the hoop direction of a rotator, as it was shown in drawing 5 , although six sheets will be inserted in the direction of a rotator laminating when permanent magnet inserted in relation top concave letter configuration hold hole which divides rotor core 1 in direction of laminating two in drawing 4 , and is carrying out laminating 2a 4a is seen by one magnetic pole. Therefore, the activity which inserts permanent magnet 4a in a rotor core 1 can be simplified. Moreover, although it is natural, since the use number of sheets of permanent magnet 4a becomes fewer, it becomes possible to also reduce the processing cost of an ingredient. In addition, the same effectiveness is acquired, even if concave letter configuration hold hole 2a and 2b are not connected with the concave letter configuration opening sections 3a and 3b or 3c, respectively and the example shown in the drawing 4 ****5 is connected.

[0028] Moreover, by drawing 6 , rotator product thickness explains the gap include angle of the rotator which was explained by drawing 4 and drawing 5 and which was shifted by the predetermined include angle to the hoop direction of a rotator like using the rotator carried out 2

****s up and down. the gap angle of the convex typeface-like rotor core 6 of concave letter configuration opening section 3a established in the edge of concave letter configuration hold hole 2a to the slot pitch of the stator in which the coil of a stator is inserted -- 1 / 2 pitch ****** -- the cogging torque produced in a rotator by things can be reduced.

[0029] The technique of reducing the cogging torque of the rotator shown by drawing 6 is explained using drawing 7 . An axis of ordinate expresses the period T of pulsation of cogging torque to (a) of drawing 7 , and the axis of abscissa shows the angle of rotation theta of a rotator to it. If cogging torque generated in a downward rotator laminating part is set to Ttheta2, using as Ttheta1 cogging torque generated in an upper rotator laminating part By shifting relatively a part for the machine angle which is equivalent to stator slot pitch 1 / 2 period in the cogging torque Ttheta2 generated in a downward rotator laminating part to the cogging torque Ttheta1 generated in an upper rotator laminating part Cogging torque can be negated with the cogging torque Ttheta2 of the opposite phase which shifted the cogging torque Ttheta1 generated in an upper rotator laminating part the term 1/2 round. In addition, the condition of having been denied by the cogging torque generated in the rotator laminating parts of the upper part and a lower part is shown in (b) of drawing 7 .

[0030] In addition, although drawing 6 and drawing 7 explained the case where 2 ****s of rotator product thickness were carried out, it is possible by dividing rotator product thickness by even pieces to reduce cogging torque by the same approach as drawing 6 and drawing 7 .

[0031] Moreover, concave letter configuration hold hole 2a which inserted the permanent magnets 4a and 4b shown in drawing 1 **** drawing 7 , The permanent magnet flush-type rotator which prepared the concave letter configuration openings 3a and 3b or 3c between the edge of 2b, and the rotator periphery The sound and vibration resulting from cogging torque can be reduced by considering as the motor which carried out opposite arrangement with the stator of the concentrated-winding method with which the direct coil was coiled around the tooth part of a stator. In six slots with especially few slots of a stator, nine slots, 12 slots, etc., the effectiveness is good.

[0032] Moreover, when the concave letter configuration openings 3a and 3b shown in drawing 1 and drawing 7 or 3c lengthens a magnetic pole core side, the convex typeface-like rotor core 6 may have the shape of a continuous convex typeface, and may have the shape of a convex typeface of discontinuity. Therefore, concave letter configuration opening 3a can be attained by applying suitably not only in a concave letter but in the range as which the shape of an easy configuration and Kushigata has and which does not deviate from the main point of this invention.

[0033] As mentioned above, although the rotator from which permanent magnet 4a was embedded at concave letter configuration hold hole 2a, it was divided in the direction of product thickness at plurality in the permanent magnet rotator which prepared concave letter configuration opening 3a in the edge of this concave letter configuration hold hole 2a, and said rotator, and each is relatively shifted by the predetermined include angle has been explained This permanent magnet embedding rotator For example, when magnetizing to a rotator using the coil of a stator after being incorporated in the sealing compressor used as the driving source for the object for air-conditioners, or refrigerators, usually, in the condition of having not prepared concave letter configuration opening 3a in the edge of concave letter configuration hold hole 2a Since the location between magnetic pole poles of a stator differs from the location between magnetic pole poles of a rotator in the rotator laminating part by the predetermined include angle deviated and a magnetization field reverser than the tooth back by the side of between [of concave letter configuration hold hole 2a] magnetic pole poles starts, it becomes impossible to magnetize permanent magnet 4a embedded at the rotator. Therefore, it was not able to magnetize to a rotator using the stator included in the sealing compressor.

[0034] However, by preparing the concave letter configuration openings 3a and 3b or 3c between concave letter configuration hold hole 2a, 2bs, and rotator peripheries which were explained by drawing 1 **** drawing 7 These concave letter configuration openings 3a and 3b or the side edge section of 3c Concave letter configuration hold hole 2a, A rotator can be magnetized without between poles shifting by the stator included in the sealing compressor, since the

reverse magnetization field which flows into a rotator can be protected from a stator by ******ing to the between [magnetic pole poles] side of the tooth back of 2b.
[0035]
[Effect of the Invention] It has the concave letter configuration hold hole which is the motor of the introvert mold which has a rotator inside a stator, and is extended to a rotator periphery focusing on the boss of a rotator. A permanent magnet is embedded at this concave letter configuration hold hole, get down, and it has an opening between the edge of a concave letter configuration hold hole, and a rotator periphery. When this opening considers as a concave letter configuration and the magnetic flux from a rotor core goes into a rotor core again through a stator core, The sound and vibration which a rapid change of magnetic flux does not occur, and the outflow close of magnetic flux is made to change gradually, are made to maintain the engine performance of a motor, and originate in cogging torque can be reduced. Especially a motor is advantageous in what is operated with a heavy load, or the enlarged thing.
[0036] Moreover, since it can be made to be able to concentrate focusing on a magnetic pole and the magnetic path of reluctance torque can be secured certainly, without leaking the magnetic flux by the permanent magnet when there is a concave letter configuration opening, the comprehensive torque of a motor can be raised sharply.
[0037] Moreover, when there is the convex typeface-like rotor core section of the opening of this concave letter configuration, it becomes possible to be able to make broad the yoke part between the opening of a concave letter configuration, and a rotator periphery, and to raise reinforcement. Therefore, without leaking magnetic flux by considering as the opening of a concave letter configuration also with the motor enlarged especially, the long and slender yoke part between the opening of a concave letter configuration and a rotator periphery can be made broad, deformation by the handling at the time of rotator manufacture etc. decreases, and a quality side improves, and it becomes, without the sound and vibration resulting from the degradation and cogging torque of a motor occurring.
[0038] Moreover, since the magnetic flux which a permanent magnet generates by connecting the concave letter configuration hold hole for embedding this concave letter configuration opening and permanent magnet is not leaked, the engine performance of a motor can be raised.
[0039] Moreover, when this rotator is divided in the direction of product thickness at plurality and a concave letter configuration opening considers as the rotator of the motor shifted by the predetermined include angle to the hoop direction of a rotator, it becomes possible to reduce the sound resulting from the cogging torque which magnetic flux will carry out [torque] outflow close to a convex typeface-like rotor core gradually, and is generated in a part for magnetic pole Mabe of a rotator, and vibration. Moreover, without shifting the concave letter configuration hold hole with which a permanent magnet is inserted, by shifting only a concave letter configuration opening by the predetermined include angle to the hoop direction of a rotator, since the use number of sheets of a permanent magnet can be reduced, working efficiency increases, and it becomes possible to reduce the cost of materials etc. Moreover, the same effectiveness as the above can obtain also by lengthening a concave letter configuration opening by the predetermined include angle toward a magnetic pole core.
[0040] Moreover, since the period of pulsation of the cogging torque which generates the concave letter configuration opening of the rotator divided in the direction of product thickness of a rotator at plurality in rotator magnetic pole pole Mabe by shifting relatively parts for one half of the include angle of the slot pitch of a stator to the hoop direction of a rotator serves as an opposite phase mutually, pulsation of cogging torque can be negated and a sound, vibration, etc. can be reduced.
[0041] Moreover, the sound and vibration resulting from cogging torque can be reduced by using the rotator by this approach for the stator of the concentrated-winding method with which it was wound around the direct coil by the tooth part of a stator.
[0042] Moreover, it has the concave letter configuration hold hole extended to a rotator periphery focusing on the boss of a rotator. In the rotator of the motor with which a permanent magnet is embedded at a concave letter configuration hold hole, and it gets down, and has an opening between the edge of a concave letter configuration hold hole, and a rotator periphery,

and this opening forms the concave letter configuration Said rotator is divided in the direction of product thickness at plurality, and also by the rotator from which the location between magnetic pole poles differs when a concave letter configuration opening considers as the rotator which has shifted to the hoop direction of a rotator by the predetermined include angle, after being included in housing, it can magnetize by making a stator into magnetization York. For example, after incorporating a stator and a rotator in the sealing compressor made into driving sources, such as a refrigerator and an air-conditioner, it becomes possible to magnetize a rotator by making a stator into magnetization York.
[0043]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The cross-sectional view of a rotator showing the example of this invention.
[Drawing 2] It is drawing showing the flow of the magnetic flux in drawing 1 .
[Drawing 3] The cross-sectional view of a rotator showing another example.
[Drawing 4] The cross-sectional view of a rotator showing another example.
[Drawing 5] The cross-sectional view of a rotator showing another example.
[Drawing 6] The partial cross-sectional view of a stator and a rotator showing another example.
[Drawing 7] The pulsating period of the cogging torque of the rotator structure shown in drawing 6 .
[Drawing 8] The cross-sectional view of a rotator showing the conventional example.
[Description of Notations]
one -- a rotor core -- two -- two -- a -- 2b -- a concave letter -- a configuration -- hold -- a hole -- three -- an opening -- three -- a -- three -- b -- three -- c -- a concave letter -- a configuration -- an opening -- three -- a -- ' -- three -- a -- ' -- ' -- a concave letter -- a configuration -- an opening -- a side edge -- the section -- four -- four -- a -- four -- b -- a permanent magnet, 5 -- boss, a 6 -- convex typeface-like rotor core, and 7 -- a stator core, 8 -- tooth edge section, and 9 -- caulking pin.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

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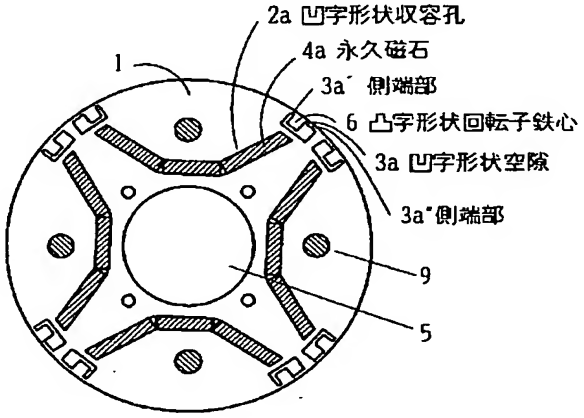
最終頁に続く

(54)【発明の名称】　電動機の回転子

(57)【要約】
【課題】電動機から発生するコギングトルクに起因する音、振動等を低減し、作業性の優れた回転子を提供する。
【解決手段】固定子の内部に回転子を有する内転型の電動機であって、前記回転子の軸孔を中心として前記回転子外周まで伸びる凹字形状収容孔を備え、前記凹字形状収容孔に永久磁石が埋め込まれており、前記凹字形状収容孔の端部と回転子外周の間には空隙を有し、前記空隙が凹字形状を形成している。また、前記回転子が積厚方向に複数に分割され前記凹字形状空隙が回転子の周方向に所定の角度分ずらすことによりコギングトルクを低減でき音、振動等を低減できる。また、ハウジングに組み込まれた後の固定子を着磁ヨークとして前記回転子を着磁することが可能であるため取り扱い作業を容易にすることができる。



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【特許請求の範囲】

【請求項１】　固定子の内部に回転子を有する内転型の電動機であって、前記回転子には永久磁石が埋め込まれた凹字形状収容孔を備え、前記回転子の軸孔を中心として前記凹字形状収容孔の端部が前記回転子外周まで伸びて形成されており、前記凹字形状収容孔の端部と回転子外周の間には空隙を有し、前記空隙が凹字形状空隙を形成していることを特徴とする電動機の回転子。

【請求項２】　前記凹字形状空隙と前記永久磁石を埋め込むための前記凹字形状収容孔とが連結されていることを特徴とする請求項１項記載の電動機の回転子。

【請求項３】　前記回転子が積厚方向に複数に分割されており、前記永久磁石が挿入される前記凹字形状収容孔及び前記凹字形状空隙が回転子の周方向に所定の角度分ずれていることを特徴とする請求項１項または請求項２項いずれか記載の電動機の回転子。

【請求項４】　前記回転子が積厚方向に複数に分割されており、前記永久磁石が挿入される前記凹字形状収容孔をずらすことなく、前記凹字形状空隙のみが回転子の周方向に所定の角度分ずれていることを特徴とする請求項１項または請求項２項いずれか記載の電動機の回転子。

【請求項５】　前記回転子が積厚方向に複数に分割されており、前記永久磁石が挿入される前記凹字形状収容孔をずらすことなく、前記凹字形状空隙を磁極中心に向かい所定の角度分伸ばしたことを特徴とする請求項１項または請求項２項いずれか記載の電動機の回転子。

【請求項６】　前記凹字形状空隙が回転子の周方向に固定子のスロットピッチの１／２の角度分ずれていることを特徴とする請求項３項及至請求項５項いずれか記載の電動機の回転子。

【請求項７】　前記回転子が固定子の歯部に直接巻線が巻かれた集中巻方式の固定子と対向配置した電動機であることを特徴とする請求項１項及至請求項６項いずれか記載の電動機の回転子。

【請求項８】　固定子の内部に回転子を有する内転型の電動機であって、前記回転子には永久磁石が埋め込まれた凹字形状収容孔を備え、前記回転子の軸孔を中心として前記凹字形状収容孔の端部が前記回転子外周まで伸びて形成されており、前記凹字形状収容孔の端部と回転子外周の間には空隙を有し、前記空隙が凹字形状空隙を形成している電動機の回転子において、前記回転子が積厚方向に複数に分割され、前記凹字形状空隙が回転子の周方向に所定の角度分ずれている回転子を、ハウジングに組み込まれた後に固定子を着磁ヨークとして着磁をすることを特徴とする回転子の着磁方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】　本発明は、産業用機器、事務用機器、家電用機器に使用される電動機の回転子に関する。

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【０００２】

【従来の技術】近年、産業用機器、事務用機器、家電用機器に使用する電動機において永久磁石を使用した永久磁石形電動機が一般的に使用されるようになってきている。永久磁石形電動機の回転子には、永久磁石の磁束量によるマグネットトルクや回転子内部に磁束通路を確保しリラクタンストルクを利用した多種多様の回転子の構造が提案されている。従来、電動機性能を上げる場合、回転子内部に埋め込んだ永久磁石の材質を高性能化したり使用量を増やして対応してきたがコスト及び回転子の構造上限界があった。

【０００３】この問題において図８のような回転子が提案されている。図８は三相４極の電動機に使用される永久磁石埋め込み形の回転子であり、隣り合う永久磁石４は異極となるように配置されている。回転子軸孔５を中心とした回転子鉄心１には、永久磁石４を挿入するための収容孔２が回転子外周に対して逆向きの円弧形状に配置されている。この円弧形状の収容孔２の回転子外周近傍には空隙３が設けられている。この空隙３は、永久磁石４によって発生した磁束を図中に示したｄ軸方向に集中させるために磁極中心の方向に大きく形成されている。これにより、磁束は磁極中心に集中することになり電動機の制御側から見た非通電区間の磁束を、通電区間に集中させることができ永久磁石の磁束を無駄なく利用し電動機の性能を向上させている。

【０００４】

【発明が解決しようとする課題】しかしながら、このような電動機においては磁束を集中させ電動機の性能を向上できる反面、各極間における磁束の流出入の差が非常に大きくなり電動機のコギングトルクに起因する音、振動等が発生している。

【０００５】特に、電動機の出力が大きく過負荷になると電動機のコギングトルクに起因する音、振動等が顕著に表れてくる。

【０００６】また、特に大型化され電動機において回転子鉄心１に永久磁石４が挿入される収容孔２の回転子外周近傍に設けられた空隙３は、磁束を磁極中心に集中させ磁極中心に向かい大きく形成されており、また、磁束が漏れない様に空隙３と回転子外周との間の継鉄部分の幅を非常に細長く幅狭としているため強度不足となり、回転子製作時の取り扱いによっては、この継鉄部分の回転子外周が変形し固定子内径とのギャップが不均一となり品質面において重要な問題となっている。このことは電動機の性能低下及び電動機のコギングトルクに起因する音、振動等となって表れてくる。

【０００７】

【課題を解決するための手段】固定子の内部に回転子を有する内転型の電動機であって、回転子には永久磁石が埋め込まれた凹字形状収容孔を備え、回転子の軸孔を中心として凹字形状収容孔の端部が回転子外周まで伸びて

形成されており、この凹字形状収容孔の端部と回転子外周の間には空隙を有し、この空隙が凹字形状空隙を形成した電動機の回転子とすることにより達成することできる。

【０００８】また、この凹字形状空隙と永久磁石を埋め込むための凹字形状収容孔とを連結することによって達成することができる。

【０００９】また、この回転子が積厚方向に複数に分割されており、永久磁石が挿入される凹字形状収容孔及び凹字形状空隙が回転子の周方向に所定の角度分ずらした電動機の回転子とすることによって達成することができる。

【００１０】また、この回転子が積厚方向に複数に分割されており、永久磁石が挿入される凹字形状収容孔をずらすことなく、凹字形状空隙のみ回転子の周方向に所定の角度分ずらした電動機の回転子とすることによって達成することができる。また、凹字形状空隙を磁極中心に向かい所定の角度分伸ばすことによっても同様の効果を得ることができる。

【００１１】また、凹字形状空隙が回転子の周方向に固定子のスロットピッチの１／２の角度分ずれている電動機の回転子とすることによって達成することができる。

【００１２】また、固定子の歯部に直接巻線が巻かれた集中巻方式の固定子と対向配置した電動機の回転子とすることによって達成することができる。

【００１３】また、前記回転子には永久磁石が埋め込まれた凹字形状収容孔を備え、この回転子の軸孔を中心として凹字形状収容孔の端部が回転子外周まで伸びて形成されており、この凹字形状収容孔の端部と回転子外周の間には空隙を有し、この空隙が凹字形状空隙を形成している電動機の回転子において、前記回転子が積厚方向に複数に分割され、凹字形状空隙が回転子の周方向に所定の角度分ずれている回転子を、ハウジングに組み込まれた後に固定子を着磁ヨークとして着磁をする回転子の着磁方法とする。例えば、冷蔵庫及びエアコン等の駆動源とする密閉圧縮機内において固定子と回転子が組み込まれた後に、固定子を着磁ヨークとして回転子を着磁することができる。

【００１４】

【発明の実施の形態】本発明の実施例について図面を用いて説明する。図１は、回転子鉄心１内部に永久磁石４ａを挿入する凹字形状収容孔２ａを有し、隣り合う凹字形状収容孔２ａに挿入された永久磁石４ａとは異極をなし４極を形成している。凹字形状収容孔２ａには永久磁石４ａが中央部底部と凹字形状収容孔側部とに分割された平板永久磁石が挿入されている。この凹字形状収容孔２ａと回転子外周部との間には、凹字形状空隙３ａを有している。凹字形状空隙３ａの底部を、凹字形状収容孔２ａの端部に面して配置し、凹字形状空隙３ａの端部を回転子外周に向かうように配置している。従って、回転子外径から見た場合、回転子鉄心１の一部分が回転子内径方向に凸字状に突出する凸字形状回転子鉄心６が形成されている。

【００１５】回転子磁極中心側に位置する凹字形状空隙３ａの端部３ａ’と回転子外周部との間の幅は、好ましくは０．３５ｍｍ～２．０ｍｍ程度がよく、回転子と固定子の間に発生する磁束が飽和するようにしている。磁束密度としては、２．０Ｔ程度となればよい。つまり、磁束を磁極中心に集中させるため凹字形状収容孔２ａに埋め込まれた永久磁石４ａによって発生する磁束を、この凹字形状空隙３ａの端部３ａ’により強制的に磁極中心に向くようにし磁束の漏れを防いでいる。このことにより、電動機の性能に寄与するマグネットトルクを上げることができ総合トルクを上げることができる。

【００１６】また、回転子磁極極間側に位置する凹字形状空隙３ａの端部３ａ’’と回転子外周部との間の幅は、前述した磁極中心側に位置する凹字形状空隙３ａの端部３ａ’幅と同様に、好ましくは０．３５ｍｍ～２．０ｍｍ程度がよく回転子と固定子の間に発生する磁束が飽和するようにしている。この場合も、磁束密度としては、２．０Ｔ程度となればよく、また、この凹字形状空隙３ａの端部３ａ’’を凹字形状収容孔２ａの幅より大きく磁極極間部まで張り出すことにより永久磁石４ａを埋め込んだ凹字形状収容孔２ａと回転子軸孔５との間に位置する回転子鉄心１の磁路の回転子外周近傍においてリラクタンストルクを集中させることができ総合トルクを上げることができる。

【００１７】また、凹字形状空隙３ａの中央の凸字回転子鉄心６は、凹字形状空隙部３ａの端部３ａ’及び３ａ’’と回転子外周部との間の幅より幅広となっている。この凹字形状空隙部３ａの端部３ａ’及び３ａ’’より幅広の凸字回転子鉄心６があることにより、リラクタンストルクを集中させた磁極極間部からマグネットトルクを集中させた磁極中心に向かい段階的に磁束を変化させ流すことができる。

【００１８】この実施例を図２において固定子鉄心７と回転子鉄心１を使用して説明する。固定子鉄心７のスロットには図示しないが固定子巻線が装着されている。固定子鉄心７からの磁束は回転子鉄心１を介して再び固定子鉄心７に入る。図中の矢印は、磁束の流れを示している。この磁束は、電動機が高負荷で運転されるものや大型化されたものでは、回転子と固定子間で非常に大きな磁束の疎密として表れる。従って、凸字形状回転子鉄心６を設けることにより段階的に磁束を流すことができる。つまり、凹字形状空隙３ａを介して磁極中心側へ磁束が流れることとなるため急激な磁束の変化がおこることがなくなる。この場合、磁極極間部側の凹字形状空隙３ａの端部３ａ’’側の空隙幅が磁極中心側の端部３ａ’側の空隙幅より幅広に設定するのが好ましい。これは磁極極間側への磁束の漏れがない様にしている。また

逆に磁極中心側の凹字形状空隙３ａの端部３ａ’側の空隙幅は、磁極極間側の端部３ａ’’側の空隙幅より狭く設定することにより端部３ａ’側の空隙を介して磁極中心側に磁束が段階的に流れるようにするためである。

尚、凸字形状回転子鉄心６を凹字形状空隙３ａの端部３ａ’側の空隙をなくして磁極中心側の回転子鉄心１と接続した状態にしてしまうと磁束が大きく流れ過ぎて電動機性能を悪化させることとなる。

【００１９】また別の効果として、この凸字形状回転子鉄心６部分を設けることにより固定子からの磁束の一部が、一旦凸字形状回転子鉄心６に流れ、更に固定子の歯端部８に戻ることにより大きな磁束を急激に流すことなく段階的に磁束を流すことができ前記方法と併用していることにより、より良い効果を得ることは言うまでもない。

【００２０】従って、この凹字形状収容孔２ａの端部に凹字形状空隙３ａを設けることにより凸字形状回転子鉄心６に意識的に磁束を流し、急激な磁束の疎密が発生しないようにしているため電動機の性能を維持させコギングトルクに起因する音、振動を低減することができる。

【００２１】また、この凹字形状空隙３ａの凸字形状回転子鉄心６があることによって、凹字形状空隙３ａと回転子外周との間の継鉄部分の幅が幅広となり継鉄部分の強度を上げることが可能となる。従って、回転子製作時の取り扱い等により回転子外周が変形することがなくなり、特に大型化された電動機の回転子の空隙部と回転子外周との間の継鉄部分の幅が細長く形成されるものにおいては、継鉄部分の幅が幅広となるため強度が上がり回転子製作時の取り扱いが容易になる。本実施例における固定子外径は好ましくはφ１８０～φ１２０、内径はφ１１０～φ６０で、電動機の定格出力は好ましくは１馬力～５馬力程度のものに適用することにより顕著な効果を得ることができる。

【００２２】また、別の実施例を図３で説明する。尚、図３以降で説明する回転子は図１及び図２に用いた回転子の構成要素と同様のものについては同じ記号を付して説明を省略する。図３には、回転子外周に伸びる永久磁石４ａが埋め込まれた凹字形状収容孔２ａの端部と、凹字形状収容孔２ａと回転子外周との間に設けた凹字形状空隙３ａが連結されて１つの収容孔として形成されている。これにより、凹字形状収容孔２ａと凹字形状空隙３ａとの間に設けられた回転子鉄心１の継鉄部がなくなり、磁極中心に向かう永久磁石４ａからの磁束を漏らすことなく有効に磁極中心に集中させることができる。

尚、図１及び図２で説明した凹字形状収容孔２ａと凹字形状空隙３ａとの間の回転子鉄心１の継鉄部は、回転子鉄心１が打ち抜き可能な限り幅狭とすることは説明をするまでもない。

【００２３】また、別の実施例を図４で説明する。図４には、回転子鉄心１の凹字形状収容孔２ａの端部に凹字形状空隙３ａを備えた永久磁石形回転子を積厚方向に２分割し積層し、周方向に所定の角度分ずらした回転子である。尚、回転子を積厚方向に２分割した場合、上方の永久磁石４ａが挿入された凹字形状収容孔２ａの端部に凹字形状空隙３ａを備えたものを実線で示し、所定の角度分ずらした下方の永久磁石４ｂが挿入された凹字形状収容孔２ｂの端部に凹字形状空隙３ｂを備えたものを破線で示している。然るに、凹字形状空隙３ａの凸字形状回転子鉄心６が回転子周方向に所定の角度分ずらした回転子とすることによって、段階的に凸字形状回転子鉄心６に磁束が流出入することになり回転子の磁極間部分で発生するコギングトルクに起因する音、振動を低減することが可能となる。

【００２４】この場合、凸字形状回転子鉄心６を所定の角度分ずらした場合、好ましくは回転子周方向で重なり合わないようにすることが望ましい。これは、本来固定子の歯端部８から回転子に入り固定子の歯端部８へ磁束を逃がす磁路を形成しなくてはならないが、積層された凸字形状回転子鉄心６が重なり合っていると、回転子鉄心１の軸方向に磁束が逃げるため大幅な性能低下に繋がるからである。

【００２５】また、図５には図４と同様に、回転子鉄心１の凹字形状収容孔２ａの端部に凹字形状空隙３ａを備えた永久磁石形回転子であり、図４のものとは異なり永久磁石４ａが挿入されている凹字形状収容孔２ａはずれることなく配置されており、凹字形状空隙部３ａのみが回転子の周方向に所定の角度分ずれて配置されている。尚、前記同様、回転子は積厚方向に２分割した場合を示しており、上方の永久磁石４ａが挿入された凹字形状収容孔２ａの端部に凹字形状空隙３ａを備えたものを実線で示し、下方の所定の角度分ずらした凹字形状空隙３ｃのみを破線で示している。

【００２６】この場合、凹字形状空隙３ａは、凹字形状空隙３ａの形状を変えることなく回転子の周方向に所定の角度分ずらしても良く、また凹字形状空隙３ａの空隙を磁極中心側に伸ばしても良い。前者においては凹字形状空隙３ａの幅に凹字形状空隙３ｃの空隙の一部が必ず重なるように設定することが好ましい。仮に、凹字形状空隙３ａの空隙と凹字形状空隙３ｃの空隙が重ならないように回転子を周方向にずらすと、この空隙の重なりのない部分において磁束が大きく漏れることになり電動機の性能を悪化させることとなる。また、後者においては、図１及び図２において説明した磁極中心側への段階的な磁束の流れが、凹字形状空隙３ａの磁極中心側３ａ’の空隙を介してであったが、この場合凹字形状空隙３ａの底部、つまり凹字形状収容孔２ａの端部側の空隙から段階的に磁束が流れることとなる。従って、この場合においては磁極極間側の凹字形状空隙３ａ’’の幅より狭く設定するのは凹字形状空隙３ａの底部の空隙部となる。前者及び後者ともに凹字形状空隙３ａの凸字形状

回転子鉄心６は積厚方向に重ならない様にすることが好ましい。

【００２７】また、図４では回転子鉄心１を積層方向に２分割して積層している関係上凹字形状収容孔２ａに挿入される永久磁石４ａは、１つの磁極で見た場合、回転子積層方向に６枚挿入することとなるが、図５に示したように凹字形状収容孔２ａを回転子の周方向にずらすことがないため３枚の永久磁石４ａを挿入するだけでよい。従って、回転子鉄心１に永久磁石４ａを挿入する作業を簡略化することができる。また、当然ではあるが、永久磁石４ａの使用枚数が減るため材料の加工コストも低減することが可能となる。尚、図４及図５に示した実施例は、其々凹字形状収容孔２ａ、２ｂが凹字形状空隙部３ａ、３ｂもしくは３ｃと連結されていなくても、連結されていても同様の効果が得られる。

【００２８】また、図６では、図４及び図５で説明した様に回転子の周方向に所定の角度分ずらした回転子のずれ角度について、回転子積厚が上下に２分割された回転子を用いて説明する。固定子の巻線が挿入される固定子のスロットピッチに対して、凹字形状収容孔２ａの端部に設けた凹字形状空隙部３ａの凸字形状回転子鉄心６のずれ角を１／２ピッチずらすことにより回転子に生じるコギングトルクを低減することができる。

【００２９】図６で示した回転子のコギングトルクを低減する手法について図７を用いて説明する。図７の（ａ）には、縦軸がコギングトルクの脈動の周期Ｔを表し、横軸は回転子の回転角度θを示している。上方の回転子積層部分で発生するコギングトルクをＴθ１として、下方の回転子積層部分で発生するコギングトルクをＴθ２とすると、上方の回転子積層部分で発生するコギングトルクＴθ１に対して下方の回転子積層部分で発生するコギングトルクＴθ２を固定子スロットピッチ１／２周期に相当する機械角分を相対的にずらすことにより、上方の回転子積層部分で発生するコギングトルクＴθ１を１／２周期ずれた逆位相のコギングトルクＴθ２でコギングトルクを打ち消すことができる。尚、図７の（ｂ）には上方と下方の回転子積層部分で発生したコギングトルクによって打ち消された状態を示している。

【００３０】尚、図６及び図７では、回転子積厚を２分割されている場合について説明したが、回転子積厚を偶数個で分割することにより図６及び図７と同様の方法でコギングトルクを低減することが可能である。

【００３１】また、図１及至図７に示した永久磁石４ａ、４ｂを挿入した凹字形状収容孔２ａ、２ｂの端部と回転子外周との間に凹字形状空隙３ａ、３ｂ、もしくは３ｃを設けた永久磁石埋め込み形回転子を、固定子の歯部に直接巻線が巻かれた集中巻方式の固定子と対向配置させた電動機とすることによってコギングトルクに起因する音、振動を低減することができる。特に、固定子のスロット数が少ない６スロット、９スロット、１２スロット等において、その効果は良好である。

【００３２】また、図１及び図７に示した凹字形状空隙３ａ、３ｂもしくは３ｃは、磁極中心側を伸ばす場合、凸字形状回転子鉄心６は、連続した凸字形状であっても良く、また、不連続の凸字形状であっても良い。従って、凹字形状空隙３ａは、凹字のみならずＥ字形状、楕形状でも良く本発明の主旨を逸脱しない範囲で適宜適用することにより達成することができる。

【００３３】以上の様に、凹字形状収容孔２ａに永久磁石４ａを埋め込み、この凹字形状収容孔２ａの端部に凹字形状空隙３ａを設けた永久磁石回転子や、前記回転子において積厚方向に複数に分割され相対的に其々が所定の角度分ずれている回転子を説明してきたが、この永久磁石埋め込み回転子を、例えばエアコン用または冷蔵庫用の駆動源となる密閉圧縮機内に組み込まれた後に固定子の巻線を利用して回転子に着磁を施す場合、通常、凹字形状収容孔２ａの端部に凹字形状空隙３ａを設けていない状態では、所定の角度分ずれた回転子積層部分において固定子の磁極極間位置と回転子の磁極極間位置とが異なるため、凹字形状収容孔２ａの磁極極間側の背面より逆の着磁磁界が係るため、回転子に埋め込まれた永久磁石４ａを着磁することができなくなる。従って、密閉圧縮機に組み込まれた固定子を利用して回転子に着磁を施すことができなかった。

【００３４】しかしながら、図１及至図７で説明したような凹字形状収容孔２ａ、２ｂと回転子外周との間に凹字形状空隙３ａ、３ｂ、もしくは３ｃを設けることにより、この凹字形状空隙３ａ、３ｂ、もしくは３ｃの側端部を凹字形状収容孔２ａ、２ｂの背面の磁極極間側まで張り出すことにより固定子から回転子に流れ込む逆の着磁磁界を防ぐことができるため密閉圧縮機に組み込まれた固定子により極間がずれることなく回転子を着磁することができる。

【００３５】

【発明の効果】固定子の内部に回転子を有する内転型の電動機であって、回転子の軸孔を中心として回転子外周まで伸びる凹字形状収容孔を備え、この凹字形状収容孔に永久磁石が埋め込まれおり、凹字形状収容孔の端部と回転子外周の間には空隙を有し、この空隙が凹字形状とすることにより回転子鉄心からの磁束は固定子鉄心を介して再び回転子鉄心に入る際、急激な磁束の変化が発生することがなく段階的に磁束の流出入を変化させることとなり電動機の性能を維持させコギングトルクに起因する音、振動を低減することができる。特に電動機が高負荷で運転されるものや大型化されたものでは有利である。

【００３６】また、凹字形状空隙があることにより永久磁石による磁束を漏れることなく磁極中心に集中させることができ、またリラクタンストルクの磁路を確実に確保することができるため電動機の総合トルクを大幅に上

げることができる。

【００３７】また、この凹字形状の空隙の凸字形状回転子鉄心部があることによって、凹字形状の空隙と回転子外周との間の継鉄部分を幅広とすることができ強度を上げることが可能となる。従って、特に大型化された電動機でも凹字形状の空隙とすることによって磁束を漏らすことなく凹字形状の空隙と回転子外周の間の細長い継鉄部分を幅広にすることができ回転子製作時の取り扱い等による変形が少なくなり品質面が向上し、電動機の性能低下やコギングトルクに起因する音、振動が発生することもなくなる。

【００３８】また、この凹字形状空隙と永久磁石を埋め込むための凹字形状収容孔とを連結することによって永久磁石が発生する磁束を漏らすことがないため電動機の性能を向上させることができる。

【００３９】また、この回転子が積厚方向に複数に分割され凹字形状空隙が回転子の周方向に所定の角度分ずらした電動機の回転子とすることによって、段階的に凸字形状の回転子鉄心に磁束が流出入することになり回転子の磁極間部分で発生するコギングトルクに起因する音、振動を低減することが可能になる。また、永久磁石が挿入される凹字形状収容孔をずらすことなく、凹字形状空隙のみ回転子の周方向に所定の角度分ずらすことによって、永久磁石の使用枚数を減らすことができるため作業効率が上がり、材料費等も低減することが可能になる。また、凹字形状空隙を磁極中心に向かい所定の角度分伸ばすことによっても前記と同様の効果が得ることができる。

【００４０】また、回転子の積厚方向に複数に分割された回転子の凹字形状空隙を、回転子の周方向に固定子のスロットピッチの１／２の角度分を相対的にずらすことにより、回転子磁極極間部で発生するコギングトルクの脈動の周期が互いに逆位相となるためコギングトルクの脈動を打ち消すことができ音、振動等低減することができる。

＊【００４１】また、この方法による回転子を固定子の歯部に直接巻線が巻かれた集中巻方式の固定子に使用することによってコギングトルクに起因する音、振動を低減することができる。

【００４２】また、回転子の軸孔を中心として回転子外周まで伸びる凹字形状収容孔を備え、凹字形状収容孔に永久磁石が埋め込まれおり、凹字形状収容孔の端部と回転子外周の間には空隙を有し、この空隙が凹字形状を形成している電動機の回転子において、前記回転子が積厚方向に複数に分割され、凹字形状空隙が回転子の周方向に所定の角度分ずれている回転子とすることにより磁極極間位置が異なる回転子でも、ハウジングに組み込まれた後に固定子を着磁ヨークとして着磁をすることができる。例えば、固定子と回転子を冷蔵庫やエアコン等の駆動源とする密閉圧縮機内に組み込んだ後に、固定子を着磁ヨークとして回転子を着磁することが可能となる。

【００４３】

【図面の簡単な説明】

【図１】本発明の実施例を示す回転子の横断面図。

【図２】図１における磁束の流れを示す図である。

【図３】別の実施例を示す回転子の横断面図。

【図４】別の実施例を示す回転子の横断面図。

【図５】別の実施例を示す回転子の横断面図。

【図６】別の実施例を示す固定子と回転子の部分横断面図。

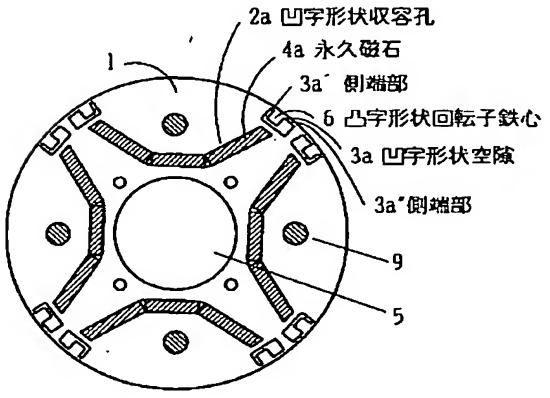
【図７】図６に示した回転子構造のコギングトルクの脈動周期。

【図８】従来例を示す回転子の横断面図。

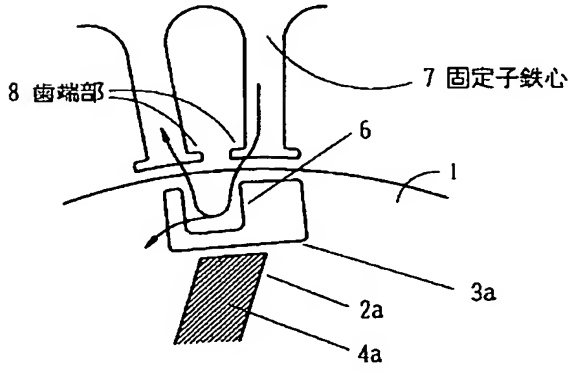
【符号の説明】

１…回転子鉄心、２，２ａ，２ｂ…凹字形状収容孔、３…空隙、３ａ，３ｂ，３ｃ…凹字形状空隙、３ａ’，３ａ’’，…凹字形状空隙の側端部、４，４ａ，４ｂ…永久磁石、５…軸孔、６…凸字形状回転子鉄心、７…固定子鉄心、８…歯端部、９…カシメピン。

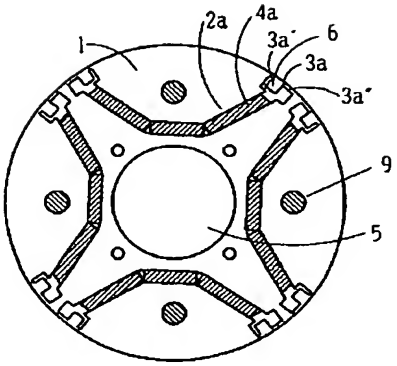
【図１】



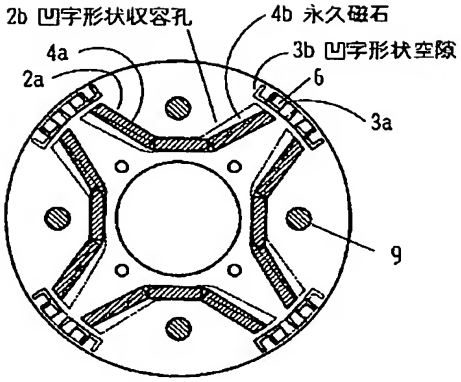
【図２】



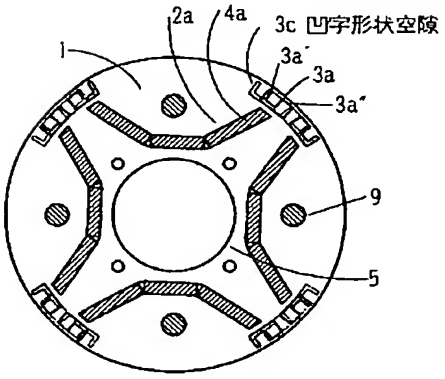
【図３】



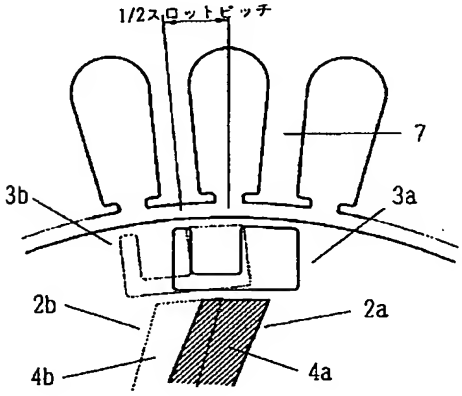
【図４】



【図５】



【図６】



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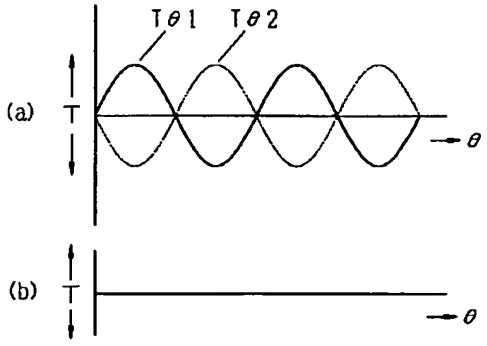

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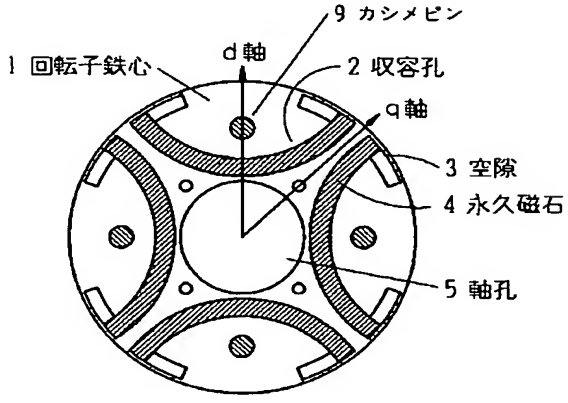

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GA16 HH01 JK02 JK05
5H622 AA02 AA03 CA02 CA07 CA13
CB01 CB05 CB06 PP10 PP11
PP19